



Marine Mammal: Background Information & Pre and Post Activities

BACKGROUND INFORMATION

BASIC ECOLOGICAL CONCEPTS

Ecology is the study of the relationships between organisms and their environments. An ecologist asks questions like: Where does this organism live and what characteristics make it particularly suited for that location? How does this organism get its food? What other organisms eat it? By asking questions such as these some basic principles have emerged. Understanding the following basic ecological concepts help us appreciate the complexity of life residing in and around the Bay.

Everything is related to everything else

Perhaps the easiest place to see interdependence in the environment is to look at food. All food on this planet is essentially made by plants through the process of *photosynthesis*. *Herbivores* are animals, which depend directly on plants for food. *Carnivores* eat herbivores. Take away all of the plants and there would be no animals. Can a plant, then, exist independently of all other organisms? No. Although it doesn't eat, a plant needs *nutrients* and is dependent on *decomposers* (bacteria and fungi) to break down dead organisms, thereby releasing these nutrients for use by the living plant.

Everything depends on something else

All organisms are also dependent on factors in the physical environment. They must have a source of water. Animals must have oxygen to breathe. Plants must have sunlight to perform photosynthesis. You can probably think of many more examples of how organisms are dependent on their environments.

Everything must go somewhere

No object ever disappears completely from the face of the earth. It may be broken down into atoms and be used to build something else, but those atoms are still there. In this way, nature deals with waste by recycling. Any plant or animal that does not become food for some animal becomes food for decomposers, which free the nutrients to be used again. Anything that cannot be decomposed must remain in the environment as it is. What are some examples of this kind of waste? The next time you throw something away, you might remember that there really is no "away" to throw it to.

Earth's resources are limited

How often do you run out of time to do what you want or need to do? Everyone knows that each day only has so much time in it, and that we have to be careful how we use it if we are going to

accomplish everything we need to. The earth's available resources are like time in that we have to be careful how we use them, or they might run out. There is only so much gold, so much petroleum, so much fresh water, so much food, and so much space. All organisms are limited by the availability of resources, but humans have a special opportunity and a special responsibility. Although plants cannot make a decision to conserve clean water, humans can. To do this intelligently we must find out how much of each resource is available and then we must budget our use. We must also think about recycling. The earth can recycle its components naturally but humans must make special efforts to preserve the natural resources.

MAMMALS

Mammals are a special group of animals that have all of the following characteristics:

1. Warm blooded;
2. Have hair or fur;
3. Breathe air through lungs;
4. Bear live young; and
5. Nurse their young with milk produced by mammary glands.

Marine mammals are a specialized sub-set of mammals, which have characteristics that allow them to live either part-time, or entirely, in water. The following is a small list of characteristics that marine mammals may possess in order to deal with life in the ocean:

- A thick layer of blubber, fat, or extremely thick fur in order to keep warm.
- Streamlined bodies in order to swim faster.
- The ability to store extra oxygen in their muscles and blood in order to stay under water for long lengths of time. They also have more blood than land mammals in proportion to their body size, and can direct their blood flow to only their vital organs (such as their heart and lungs). Furthermore, many marine mammals can slow their heartbeat down so they are using less oxygen during a dive under water.
- Blowholes or adapted nostrils to allow easier breathing while at the surface of the water.

All marine mammals belong to the kingdom Animalia, phylum Chordata and class Mammalia. The following chart provides a quick description of the different characteristics of each division of marine mammals.

Class Mammalia:

Organisms having the five distinctive features listed above.

Order Carnivora. All organisms in this order have sharp canine teeth designed for removing flesh from carcasses.

Suborder Pinnipedia: Flipper footed marine mammals. Pinnipeds can safely come out on land to rest, breed, and give birth.

Family Otariidae: Sea lions and fur seals. These pinnipeds have visible external ear flaps and can “walk” on all four flippers by rotating their rear flippers forward. A local example of this family is the California Sea Lion.

Family Phocidae: True seals, such as harbor seals and elephant seals. These pinnipeds have no external ear flaps and can only crawl on land because their front flippers are small and their hind flippers cannot rotate forward. A local example of this family is the Harbor Seal.

Family Odobenidae: Walruses. These pinnipeds are distinctive for their long tusks. These animals inhabit the Arctic seas and ice floes.

Suborder Fissipedia: This suborder includes all other marine mammals in the order Carnivora.

Family Mustelidea: Sea Otters. The only member of this family that is a marine mammal is the sea otter. River otters are considered land mammals. Sea otters are the smallest marine mammal and they inhabit coastal kelp forests. Sea otters are found locally, in the Monterey Bay.

Family Ursidae: Polar Bears. Polar bears are designated as marine mammals because they depend on the ocean for a majority of their food. Polar bears range throughout the Arctic regions, including parts of Alaska.

Order Cetacea: Whales, Dolphins & Porpoises. The animals of this order are completely aquatic and therefore can't live on land. They have two (2) front flippers and their tails are uniquely shaped into two horizontal extensions, called flukes.

Suborder Odontoceti: Toothed Whales. This suborder includes dolphins, porpoises and whales. Odontocetes have varying numbers of teeth, or may have no functional teeth at all. Odontocetes also have only one (1) blowhole. Local examples of this suborder are common dolphins.

Suborder Mysticeti: Baleen Whales. This suborder has rows of strong baleen plates along either side of their upper jaw used to filter small prey.

Mysticetes breathe through a pair (2) of blowholes. Local examples of this suborder are Grey Whales and Blue Whales.

Order Sirenia: Dugongs and manatees. These marine mammals live in warm or tropical waters and feed on plants. In the United States, the only example of this order is Manatees found in coastal Florida.

SAN FRANCISCO BAY PINNIPED ADAPTATIONS

The word *pinniped* means feather-footed, and refers to the fact that this group of marine mammals have front and hind flippers. Animals that belong to this group are seals, sea lions and walruses.

Millions of years ago, the ancestors of these animals lived on land, as is the case with all marine mammals. The ancestors of Pinnipeds were probably weasels or bear-like animals that spent much time in the water and eventually adapted to the marine environment. There are three families of Pinnipeds:

Phocidae – “true” seals;
Otariidae – eared seals; and
Odobenidae – walruses.

Phocids, or “true” seals, such as the harbor seal, are often seen in the waters of the San Francisco Bay. There are many species of Phocids, but you can always recognize them by their ears and flippers. True seals have ear holes, but no external ear flaps. They also have very small front flippers, which makes it very hard for them to maneuver on land. When on land, they are usually seen flopping around on their bellies. When swimming, they move their rear (foot) flippers back and forth like a fish’s tail for power.

Family Otariidae includes sea lions and fur seals. Otariids that are local to the Bay area are the California sea lion and Northern fur seal. Otariids are easily recognized by their earflaps and flippers. Unlike phocids, they have external ear flaps and large front flippers that can rotate. These front flippers allow them to walk on land. In the water, they use these front flippers like oars to power their bodies.

The third family of pinnipeds are the walruses or odobenids. There are no local species of walruses. These animals have a combination of traits found in phocids and otariids including no external ear flaps but the ability to rotate their hind flippers. Both males and females of this group have tusks and vacuum-like mouths for sucking up shellfish from the ocean floor. All walruses are found in the Northern Atlantic and Pacific oceans.

Harbor Seal (Phoca vitulina)	
Description	Harbor seals have spotted coats in a variety of shades from silver-gray to black or dark brown. They reach 5-6 feet and weigh up to 370 pounds. Males are slightly larger and heavier than females.
Habitat/Range	In the northeast Pacific, they range from Alaska to Baja California, Mexico. They favor near-shore coastal waters and are often seen at sandy beaches, mudflats, bays, and estuaries. In California, the estimated population was 40,000 in 1997.
Behavior	Harbor seals spend about ½ of their time on land and ½ of their time in water, and sometimes even sleep in the water! They can dive to 1,500 feet for up to 40 minutes.
Food	Harbor seals are opportunistic feeders that eat sole, flounder, sculpin, hake, cod, herring, octopus and squid.
Fun Facts	In San Francisco Bay, many harbor seals are reddish in color. This may be caused by an accumulation of trace elements such as iron or selenium in the ocean.

California Sea Lion (Zalophus californianus)	
Description	Their color ranges from chocolate brown in males to lighter, golden brown in females. Males may reach 1,000 lbs. and seven feet in length. Females grow to 220 lbs. and up to six feet in length. At around five years of age, males develop a bony bump on the top of their skull called a sagittal crest.
Habitat/Range	California sea lions are found from Vancouver Island, British Columbia to the southern tip of Baja California, Mexico.
Behavior	California sea lions are very social animals, and groups often rest closely packed together at favored haul-out sites on land, or float together on the ocean's surface in "rafts."
Food	California sea lions are opportunistic eaters, feeding on squid, octopus, herring, rockfish, mackerel, and small sharks.
Fun Facts	During the breeding season, males patrol their territories and bark almost continuously.

SAN FRANCISCO BAY CETACEAN ADAPTATIONS

The word *cetacean* comes from the Latin word "cetus" for whale. Animals that belong to this group are whales, dolphins and porpoises. Millions of years ago, the ancestors of these animals lived on land, as is the case with all marine mammals. The ancestors of Cetaceans were

probably small dogs that were more closely related to hippos, and went into the ocean about 60 million years ago. Over time, their front legs turned into paddle-shaped flippers. Also, they lost their back legs and their tails grew larger and widened to form their “fluke.” They developed a thick layer of fat used to keep warm in the cold ocean water. Furthermore, their skulls elongated and eventually their nostrils shifted to the top and back of their head to make breathing on the ocean’s surface easier. There are two suborders of cetaceans:

- Odontoceti – toothed whales; and
- Mysticeti - baleen whales.

Odontocetes are rarely seen in the waters of the San Francisco Bay because of the shallow nature of the estuary. Members of this group include killer whales and common dolphins. Odontocetes are easily recognized because they have teeth! They also have just one opening at their blowhole. There are over 73 species of odontocetes worldwide. Toothed whales tend to be social animals and are often found living in groups. They also have the special ability to detect objects in their environment through echolocation. They produce sound waves in the air passages in their head, which is then projected in front of them like radar. These sound waves bounce off of solid objects and return to them so that the animals are able to get a “picture” of what is around them. Many odontocetes use this special ability to find, and possibly stun, prey.

Dolphins, porpoises and toothed whales all belong to the Odontocete suborder. Therefore, dolphins and porpoises can all be considered small whales. However, dolphins and porpoises differ in the type of teeth that they have. Dolphins have sharp conical teeth, while porpoises have spade-shaped teeth. This trait is what scientists’ use when classifying dolphins and porpoises. Also, dolphins tend to have a pointed beak and a curved dorsal fin, when compared to porpoises, but there are exceptions to this rule.

Members of the suborder Mysticeti include the grey whale and blue whale. Grey whales are occasionally seen in the San Francisco Bay. There are 11 species of Mysticetes in the world. Mysticetes are also known as baleen whales because they have hundreds of rows of baleen plates in their mouth instead of teeth. These baleen plates are made out of keratin (the same substance our fingernails). These plates are often shaped to look like brooms and act like filters to strain food from the water. Most baleen whales feed by taking gulps of water into their mouth and then force the water back through the baleen with their tongues. The food, such as plankton and small shrimp, are trapped in the baleen and get eaten. This group includes the largest mammal on earth, the blue whale. Baleen whales have two blowholes instead of one.

Baleen whales can be further divided into three groups based on their specific feeding strategy. The rorqual whales (the largest group of baleen whales), such as blue whales, feed by trapping water in their mouths and raising their tongue, which forces the water through their baleen. All species in this group have throat pleats, which allow their throat to expand to hold this large amount of water. The second group are the skimmers, which includes right whales. These whales swim along the surface of the water with a gap in their mouth in front of their long

baleen. Their food gets trapped in the baleen and the filtered water flows out through gaps on the side of their mouth. The third group of whales are the mud suckers, which has only one member, the gray whale. Gray whales feed on the amphipods that live in the benthic mud of shallow areas, such as the San Francisco Bay, by turning on their sides and slurping the mud through the sides of their mouth.

Gray Whale (Eschrichtius robustus)	
Description	Gray whales are medium sized whales, reaching up to 49 feet in length, with the females usually being larger than the males. They are gray with white patches, which mostly consist of areas where barnacles and lice have attached themselves to the whales. Gray whales have approximately 300 plates of cream-colored baleen hanging from their upper jaw. Their blows are usually columnar or bushy in shape.
Habitat/Range	Gray whales are found only in the Pacific Ocean due to hunting in the Atlantic Ocean during the 17 th century. They are long migrators. Some groups swim from the northern parts of Alaska to Baja Mexico yearly! The current population estimate is 26,000.
Behavior	Gray whales are generally coastal animals, and frequently travel alone. Migrating whales breathe and dive in predictable patterns.
Food	They mostly feed on amphipods filtered from benthic sediment.
Fun Facts	Gray whales usually carry over 400 pounds of barnacles and whale lice.

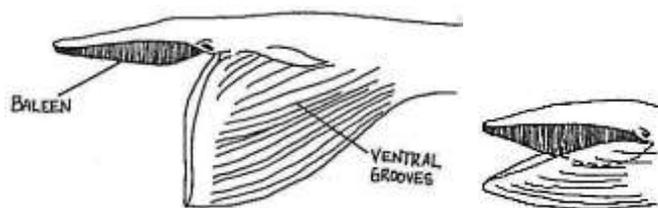
Blue Whale (Balaenoptera musculus)	
Description	Blue whales are the largest animal inhabiting the earth, reaching a length of 110 feet in length and weighing up to 400,000 lbs. They are a mottled blue-gray color. Blue whales are long and streamlined and their dorsal fins are very small. Blue whales have over 800 plates of black baleen in their mouth. Their blow is very tall and columnar.
Habitat/Range	Blue whales have been found in every ocean and are usually found swimming individually or in small groups. About 2,000 blue whales live off the coast of California.
Behavior	Not much is known about the social structure of blue whales. They tend to travel alone or in small groups.
Food	Blue whales generally feed during the polar summers, when the waters around the Channel Islands, Monterey Bay, and the Farallon Islands are teeming with krill.
Fun Facts	Blue whales have the loudest voice in the animal kingdom. They emit low-frequency sounds that travel hundreds of miles.

Orca or Killer Whale (<i>Orcinus orca</i>)	
Description	Orcas have familiar black and white coloration. Male orcas reach 30 feet in length, weigh over 6 tons, and have a dorsal fin that can be up to 6 feet tall. Females grow to be 26 feet long, weigh about 4 tons, and have a 3-foot high dorsal fin. Orcas have 50 conical teeth, which classify them as a dolphin.
Habitat/Range	Orcas are found in all oceans of the world, but favor cool waters. Some orca populations remain local and others are transient and move over great distances.
Behavior	Orcas are very social and generally live in pods or groups of up to 50 individuals. Studies have shown that each pod has its own distinctive accent, and that because of this accent, members of the same pod can recognize each other.
Food	Resident populations of orcas eat primarily fish while transient populations of orcas primarily eat marine mammals.
Fun Facts	At birth, orcas are 7 feet long and weigh almost 400 pounds. Orcas are not endangered, with at least 180,000 individuals in the Antarctic waters alone!

WHALE FEEDING

Though all whales are classified in the order Cetacea, two different groups of whales exist. Whales with baleen are grouped in the suborder Mysticeti, and whales with teeth are grouped in the suborder Odontoceti.

The Baleen whales have a comb-like or sieve-like apparatus, which allows them to strain millions of small shrimp-like crustaceans from the water. Baleen fibers are made of the same material as our fingernails or a cat's claw. The baleen plates hang in rows from the upper jaw of the whale. The plates fray toward the inside of the mouth and overlap to form a dense net. After a whale swallows a mouth full of food and water, it closes its jaws. With a thrust of the tongue, the water is expelled through the baleen, leaving the prey trapped inside. A baleen whale that uses this method of feeding is called a strainer. A Gray Whale is an example of a strainer.

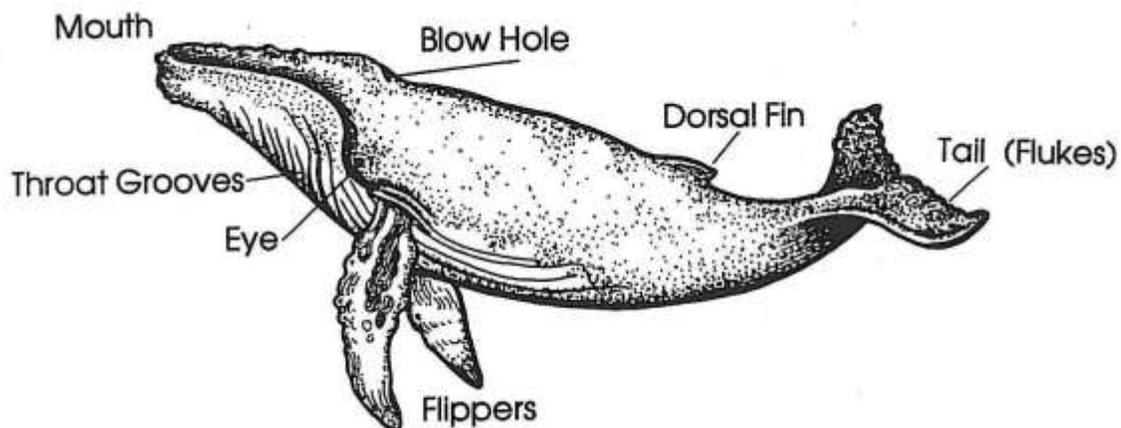


Gulper and bubble net feeders are variations of the strainer technique. A “gulper” baleen whale is one that has ventral plates on the lower jaw. Ventral plates are slits that can expand out to allow the whale to take in huge mouthfuls of water. Scientists classify this type of feeder in the family of Rorqual whales. Blue whales have more than 40 throat grooves that extend from the throat to the navel. During the breeding season, blue whales must eat 2-4 tons of krill a day. Some Rorqual whales can take in over 2 tons of water at once.



Bubble net feeding is a strategy unique to Humpback whales. It is a method where one or several whales blow a ring of bubbles with their blowhole that “net” the krill or fish that they are feeding on. The whales then swim through the “net” with their mouths agape, taking in large amounts of food.

Toothed whales search far and long in the open waters to find the fish, squid or seals that may be their preferred food. All toothed whales use echolocation to assist in hunting. This technique is a unique adaptation. Echolocation describes the release of sound waves into the water. These sound waves will eventually hit an object and echo back. As soon as the whale receives the echo it can determine the size, shape, direction of movement, and distance of an object in the water.



GLOSSARY

ADAPTATION	Modification of an organism in order to survive within its habitat.
BENTHOS	The substrate at the bottom of a body of water; the adjectival form of benthos is benthic.
BIODIVERSITY	The richness, abundance and variety of life across all trophic levels of which all ecological systems, including the planet earth, are comprised.
CAMOUFLAGE	Method of hiding in which organisms blend in with their surroundings.
CARNIVORE	An animal that consumes other living animals.
COMMUNITY	A group of plants or animals living in the same area and depending on one another for survival.
CONSUMER	An organism that gets its nutrients by eating other organisms.
CRUSTACEAN	An animal with a hard outside shell, antennae, mandibles and compound eyes. e.g. crabs, shrimps and barnacles.
DEPOSIT FEEDER	An animal that feeds by ingesting substrate and filtering out the small organic particles on the substrate.
ECHOLOCATION	The use of echoes to navigate or locate prey; sonar used by toothed whales.
ECOLOGY	The study of relationships between organisms and their environment.
EDGE COMMUNITY	A productive area where land and sea interface. This community, because of its proximity to land, receives huge inputs of sediment, nutrients and freshwater, which in turn supports a diversity of plants and animals.
ENDANGERED	An organism that is threatened with extinction.
ENVIRONMENT	The sum of all physical and biological factors that affect an organism.
FILTER FEEDER	An animal which extracts food particles by straining the water. Examples of filter feeders are clams, oysters, sponges and some fish.
FOOD CHAIN	A sequence of living organisms in an ecosystem in which members of one level feed on those in the level below and in turn are eaten by those in the level above them.
FOOD WEB	An assemblage of organisms in an ecosystem, including plants, herbivores and carnivores, which shows the relationship of "who eats whom."
HABITAT	The particular area in which an organism normally lives.
HERBIVORE	An animal that eats plants.
INVERTEBRATE	An animal without a backbone.
NERITIC ZONE	The area of the open water that lies over the continental shelf and where there are commonly interactions with seafloor organisms.

NUTRIENTS	The raw materials necessary for continuing life processes.
OCEANIC ZONE	The area that encompasses the open water that lies beyond the continental shelf.
OMNIVORE	An organism that eats both plant and animal material.
PELAGIC	Living or occurring in the open ocean.
PHOTIC ZONE	Upper sunlight portion of the water column. The depth of the photic zone in the ocean ranges from 30 to 200 meters.
PHOTOSYNTHESIS	The process used by plants to make food; in this process light energy is used to combine carbon dioxide and water to make carbohydrates (sugar and starch); oxygen gas is given off as a by-product.
PHYTOPLANKTON	Algae, usually microscopic, which freely drift in the sunlit portions of the water column.
PLANKTON	Drifting aquatic plants and animals; the adjectival form of plankton is planktonic, and a planktonic organism is called a plankter.
POLLUTION	Harmful impact on the environment resulting from human activities.
PREDATOR	An animal that captures other animals for food.
PREY	An animal caught for food.
PRODUCER	An organism that makes its own food; an example of a producer is a green plant.
SALINITY	The amount of salt in the water. Measured in parts per thousand.
SCAVENGER	An organism that is an opportunistic feeder; scavengers usually include dead and decaying animal flesh in their diets.
SPECIES	A population of plants or animals that are able to produce viable offspring with each other and not with other species.
TIDES	The daily rise and fall of the sea level along a shore, occurs twice a day on our local shores.
TUBERCLE	Small, round bumps that increase the surface area of the skin.
VERTEBRATE	An animal with a backbone. The back bone can be made of bone or of cartilage like in some fish (sharks and rays).
VIVIPAROUS	Reproductive strategy where mothers bear young that are nourished through a placental attachment (live birth).
ZOOPLANKTON	Animal plankton

PRE-VISIT ACTIVITIES

You may want to ask your librarian to set aside ecology or marine science books for your class, or ask students to bring books and magazines from home to share.

SCIENTIFIC CLASSIFICATION

Demonstrate the meaning of scientific classification by having students categorize inanimate objects according to their own framework. You could use fruit, or something ordinary such as different kinds of nails (wood, standard, aluminum, galvanized, ringed, headless), to each small group. Have them categorize and then share their results with each other to start a general discussion on classification. Do we need it? Is any one type of classification better than another? Is there a benefit to sticking to one standardized system of classification?

POST-VISIT ACTIVITIES

WRITING THANK YOU LETTERS

Write letters to the instructors and/or your class sponsor to tell them about the trip. When we receive letters and pictures back from the kids our instructors remember what a thrill it is to be teachers. The sponsors also enjoy getting direct feedback from the class and teacher to reinforce that they are making a difference for kids learning science. Please include the day, date and time of your trip so we can try to remember your group a little better.